

NOISE IMPACT ASSESSMENT

For: 90 London Street
Reading, Berkshire
RG1 4SJ

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3 March 2023

Issue 2

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ISSUE HISTORY

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1.0 EXECUTIVE SUMMARY

Site and Proposed Development

- Located in Reading, Berkshire, RG1 4SJ, the site proposes a change of use to provide 6 residential dwellings (Use Class C3) and one commercial unit (Use Class E).

Noise Impact Assessment

- An environmental noise survey was undertaken at the site in order to evaluate the existing noise climate.
- The main noise source has been identified as traffic noise from cars on London Street.
- Results from the environmental noise survey have been used to calibrate a 3D noise map created using commercial noise mapping software (SoundPLAN)
- Rooms overlooking London Street may experience noise levels in excess of LAeq= 60dB during the daytime and an estimated noise level of LAeq= 55 to 60 dBA at night-time.
- Within the rear car park, the noise level estimated is around LAeq= 50 dBA at daytime and LAeq= 45 dBA at night time.

Indoor Ambient Noise Levels

- The sound insulation performance of external walls and glazing elements have been suggested considering the estimated external noise levels in order to meet the relevant standards for indoor ambient noise levels. (BS 8233).

Overheating Study

- To mitigate overheating conditions in residential rooms, occupants will rely on opening windows as well as external shading.
- Following the Acoustics Ventilation and Overheating Residential Design Guide, maximum opening areas have been given for bedrooms in order to avoid exceeding 42dB LAeq,T at night-time.

Noise Impact from External Plant

- There are no External Plants existing or proposed on site. However, if one was to be fitted:
- Based on the measured representative background noise level, it is suggested that noise from plant operation (excluding emergency plant) would not exceed a Noise Rating Level of 44 dB LA_r during the daytime (07:00-23:00) and 37 dB LA_r at night (23:00-07:00) when assessed at the nearest noise sensitive receptors.
- There is no proposal for a domestic Air Source Heat Pump (ASHP) plant equipment, but if one was to be fitted, it would be consistent with achieving a combined noise rating level that does not exceed the representative background level. In accordance with the relevant standard (BS 4142), "this is an indication of the specific sound source having a low impact".

2.0 INTRODUCTION

This Noise Assessment outlines the following aspects:

- A summary of the relevant National and Local policies, standards and regulations
- An environmental noise survey of the development site.
- A 3D noise map of the proposed development area using commercial 3D noise-mapping software to assess, together with measured noise level results, the variation in environmental noise levels across the site
- Performance requirements for the façade and façade ventilators to meet proposed indoor ambient noise level targets
- Appropriate plant noise emission limits
- Comparison of proposals against relevant planning policies

3.0 NATIONAL AND LOCAL POLICIES

3.1 National Planning Policy

National Planning Policy Framework

The NPPF states in paragraph 170e, that planning policies and decisions should contribute to and enhance the natural and local environment by *“preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability”*.

Furthermore, it states in paragraphs 180 and 182 that planning policies and decisions should:

- mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life [paragraph 180 a)]
- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason [paragraph 180 b)]
- be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established [paragraph 182].

Noise Policy Statement for England

The NPPF document also refers to the Noise Policy Statement for England (March 2010). The Noise Policy Statement for England (NPSE) sets out (paragraph 1.6) the long term vision of Government noise policy: *“Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.”*

The NPSE also states: *“Excessive noise can have wide-ranging impacts on the quality of human life, health (for example owing to annoyance or sleep disturbance) and use and enjoyment of areas of value such as quiet places and areas with high landscape quality.”*

The NPSE also cites (in the Explanatory Note section) the following three aims:

1. Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
2. Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
3. Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

The NPSE also states (paragraph 2.2) that *“examples of noise management can be found in many areas including reducing noise source; the use of the land use and transport planning systems, compensation measures, the statutory nuisance and licensing regimes and other related legislation.”*

The NPSE (in the Explanatory Note section) also introduces guidance to assist in defining the adverse impacts:

- NOEL – No Observed Effect Level: this is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to noise.
- LOAEL – Lowest Observed Adverse Effect Level: this is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level: this is the level above which significant adverse effects on health and quality of life occur.

These categories are discussed further in the Planning Practice Guidance section below.

The NPSE acknowledges (paragraph 2.15) that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations.

Planning Practice Guidance

The government's Planning Practice Guidance web pages provide advice of various issues, including noise ¹.

The advice (March 2014, latest update July 2019) states in the context of considering when noise is relevant to planning, *"noise needs to be considered when new development may create additional noise, or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced)."* (Paragraph: 001, Reference ID: 30-001-20190722, Revision date: 22-07-2019.)

The Planning Practice Guidance pages also include more explanation of the effect level categories noted above, providing an explanatory Noise Exposure Hierarchy Table, which explores how actions such as a requirement for noise mitigation, or prevention of a development, might be assessed with respect to whether noise levels are considered above the category thresholds.

The Noise Exposure Hierarchy Table (Paragraph: 005, Reference ID: 30-005-20190722, Revision date: 22-07-2019) is given in this report in Appendix B.

¹ <https://www.gov.uk/guidance/noise--2>

3.2 Local Policies

This document sets out the Council's approach and policies of the Reading Borough for the period as they stand at the date this document was produced.

In Sections 12.37 to 12.39 of this document, strategies are set out to minimise the adverse impacts of noise and vibration; some of those include:

- Ensuring that new development with a potential for causing noise nuisance are sited away from noise-sensitive land uses, both existing and known proposed developments
- Making use of British Standard 6472-1:2008 to evaluate exposure to vibration within building
- Using design measures such as orientation, layout and double glazing to reduce noise within buildings

Planning Practice Guidance provides further information on how noise and vibration should be considered in the planning process, and Policy NE6 reflects this approach.

An extract of Policy NE6 section G and H is reproduced in Figure 1

Noise and Vibration

- G. A Noise and Vibration Impact Assessment will be required for proposals with the potential to cause disturbance to people or the natural environment due to noise and/or vibration and for proposals that are considered to be sensitive to noise and/or vibration. Proposals that would result in or be subject to noise pollution and/or vibration that is:
1. Very disruptive and would have an unacceptable adverse effect on human health or the natural environment or the tranquillity and enjoyment of the countryside will not be permitted.
 2. Disruptive and would have a significant adverse effect on human health or the natural environment or the tranquillity and enjoyment of the countryside will be refused unless the need for, and benefits of, the development significantly outweigh the harm and all feasible solutions to avoid and mitigate that harm have been fully implemented.
 3. Intrusive and would have an adverse effect on human health or the natural environment or the tranquillity enjoyment of the countryside will be resisted unless the need for, and benefits of, the development outweigh the harm and all feasible solutions to avoid and mitigate that harm have been fully implemented.
- H. Proposals adjacent or within 100m of existing or proposed major roads, heavily trafficked roads, and railways will be required to adopt setbacks and landscaping measures to provide screening and acoustic buffers to protect the amenity of proposed buildings and areas of outdoor amenity space.

4.0 REGULATIONS AND STANDARDS

Overview

The new development will be required to meet the following regulatory requirements:

- National and Local Planning Requirements which are concerned with protecting the new development from existing sources of noise and with protecting existing neighbours from noise impact from the new development
- Building Regulation Requirements which are concerned with internal sound insulation (i.e. the performance of internal floors and walls)

In addition to the regulatory requirements, the new development may be designed to meet additional good practice acoustic standards:

- Consideration of indoor ambient noise levels in residential areas for the summertime condition (i.e. when windows are open to mitigate overheating)
- British Standards which are concerned with internal ambient noise levels

4.1 Building Regulation – Approved Document Part E

Approved Document Part E (ADE) of the Building Regulations is intended to:

- provide protection against sound from other parts of the building and adjoining buildings
- provide protection against sound within a dwelling, house or flat
- prevent reverberation in the common internal parts of buildings containing flats

The key minimum requirements defined in Approved Document E for new developments are the following:

- walls and floors separating flats from other parts of the building must deliver an in situ airborne noise insulation of at least 45 dB $D_{nT,w}+C_{tr}$;
- floors separating flats from other parts of the building must deliver an in situ impact noise insulation of no more than 62 dB $L'_{nT,w}$;
- internal walls and floors (to/between bedrooms/bathrooms) must be rated a minimum of 40 dB R_w ;
- appropriate sound insulation performance between domestic and non-domestic spaces is provided based on individual assessment of the uses of the non-domestic spaces;
- pipes and ducts that penetrate floors separating habitable rooms must be enclosed for their full height in each flat. The enclosure should be constructed of material having a mass per unit area of at least 15 kg/m² with the enclosure lined or pipes lagged with 25 mm minimum of un-faced mineral fibre;
- doors to flats must have a minimum sound reduction index of 29dB R_w measured in laboratory;
- common areas such as corridors, stairwell, hallways and entrance halls which give access to the flats must be provided with an adequate reverberation control;
- pre-completion testing must be carried out by a UKAS/ANC accredited tester to demonstrate insulation requirements are met for a representative sample of flats (and any remedial action taken)

4.2 British Standard 8233:2014

British Standard 8233:2014 – *Guidance on sound insulation and noise reduction for buildings* (BS 8233)² provides guidance on internal ambient noise levels, resulting from break-in of external environmental noise that should not be exceeded in various locations within dwellings.

Guidelines for buildings in terms of internal noise level are reported in Table 1.

Activity	Location	Day time (07:00 to 23:00)	Night time (23:00 to 07:00)
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room	40 dB $L_{Aeq,16hour}$	-
Sleeping (day time resting)	Bed room	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Table 1: Indoor ambient noise levels for dwellings, as set out in BS 8233:2014 - Table 4

The standard clarifies that these values are based on the existing guidelines issued by the World Health Organisation (WHO). In addition, it states that the internal noise levels may be relaxed by up to 5 dB whilst maintaining a reasonable living condition. Conversely, in terms of internal maximum levels to be achieved during the night, the standard does not recommend any limits for individual noise events. However, a guideline value may be set in terms of SEL or L_{AFmax} , depending on the type and the number of events per night.

Furthermore, BS 8233 provides guidance on desirable noise levels in areas that are intended to be used for external amenity space, such as gardens, balconies and roof gardens which are intended to be used for relaxation. For these spaces it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ up to a level of 55 dB $L_{Aeq,T}$ for noisier environments.

4.3 British Standard 6472-1:2008

British Standard 6472-1:2008 – *Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting* (BS 6472)³ provides an assessment method for exposure to continuous vibration in residential buildings. The effect of building vibration on people within is assessed by finding the Vibration Dose Value (VDV) for both day time (16 hours) and night time (8 hours); their significance is given in Table 2.

Place and time	Low VDV $m/s^{1.75}$	Adverse possible VDV $m/s^{1.75}$	Adverse probable VDV $m/s^{1.75}$
Residential buildings Daytime 16 h (07,00 – 23,00)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings Night-time 16 h (23,00 – 7,00)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 2: Vibration level ranges and their risk of complaint, as set out in BS 6472-1:2008 – Table 1

² BSI Group, BS 8233:2014 – Guidance on sound insulation and noise reduction for buildings (2014)

³ BSI Group, BS 6472-1:2008 – Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting (2008)

4.4 British Standard 4142:2014

British Standard 4142:2014 - *Methods for rating and assessing industrial and commercial sound*, sets the methodology for rating and assessing sound of an industrial and commercial nature, which includes sound from fixed installations such as mechanical and electrical plant and equipment.

In BS 4142:2014, a noise rating is determined and compared with the existing local background sound level based on several more cumulative acoustic feature corrections to apply where appropriate. For example if the noise includes a distinguishable tone, impulse, intermittency or other readily distinguishable sound characteristic, then additional *cumulative* penalties individually ranging from 0 to 9 dB may be applied depending on the type of noise.

BS 4142:2014 seeks to determine a “representative” background sound level, stating that “...*the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods*”.

The assessment of the impact depends upon the margin by which the rating level of the specific sound source exceeds the background sound level but also promotes a consideration of the context in which the sound occurs when making an assessment. BS 4142:2014 states that an initial estimate of the impact of the specific sound is made by subtracting the measured background sound level from the rating level, while considering the following points:

- a) Typically, the greater this difference, the greater the magnitude of the impact.
- b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Note then, a BS 4142:2014 assessment may deduce a low impact where the specific sound level is below the background sound level.

4.5 Acoustics Ventilation and Overheating Residential Design Guide – (AVO Guide)

Overview

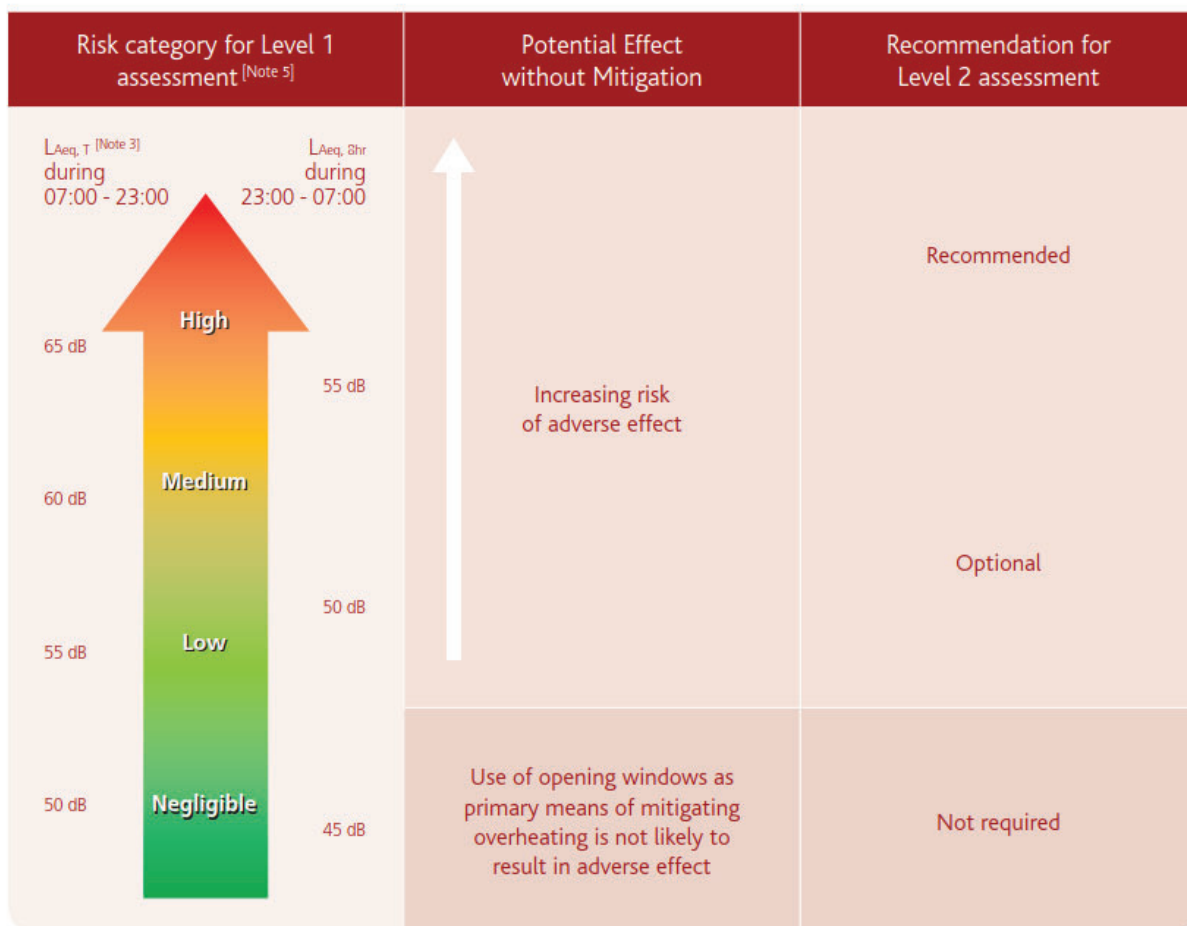
The noise levels described in BS 8233 apply when the dwelling is being ventilated at the Part F whole dwelling ventilation rate. For example with the MVHR unit running but with windows closed.

However, MVHR does not typically provide sufficient ventilation to mitigate overheating, which is normally controlled by opening windows to provide a significantly higher rate of ventilation. In this scenario, the sound level difference due to the opened window will drop to around 12dB (depending on the extent of the opening). This would mean that during the summer months occupants may be subjected to higher internal noise levels. Especially during the night, this situation could cause significant adverse effects such as difficulty in getting to sleep and premature awakenings.

Typically, planning conditions do not cover this scenario and it is not controlled via the building regulations. However, it is an important design consideration and significant adverse effects should be avoided where possible.

The Association of Noise Consultants (ANC) and Institute of Acoustics (IOA) have recently published the document Acoustics Ventilation and Overheating Residential Design Guide⁴ (AVO), which provides guidance on making an assessment of acoustics during the overheating condition. Figure 2 reproduces the AVO Guide Table 3-2, which provides a ‘Level 1’ risk assessment guide based on external free field ambient noise levels for dwellings relying on opening windows to mitigate summertime overheating.

An assessment of the proposed development, broadly following this AVO Guide methodology, is presented in this report.



⁴ <https://www.association-of-noise-consultants.co.uk/wp-content/uploads/2019/12/ANC-AVO-Residential-Design-Guide-January-2020-v1.1-1.pdf>

5.0 PROPOSED PERFORMANCE STANDARDS

Local plans, together with any neighbourhood adopted plans are the starting point for considering whether planning applications can be approved.

Based on the local policies, Building Regulations, and British Standards introduced so far, we believe that Council will apply the following acoustic criteria:

- Delivering targets according to BS 8233 (see Table 1) and BS 6472 (see Table 2)
- Plant noise to achieve a rating level below the representative background sound level in accordance with BS 4142:2014
- New development to achieve the minimum requirements defined in the Approved Document E of the Building Regulation

For additional good practice acoustic design, it is proposed to:

- Avoid AVO Level 1 'high' risk category for overheating condition.
- Where a Level 1 'high' risk category does occur, perform an AVO Level 2 risk assessment with an aim to avoiding >50 dB $L_{Aeq,16hr}$ day or >42 dB $L_{Aeq,8hr}$ night internal ambient noise levels in the overheating condition.
- Target minimum +3 dB relative to Part E standard for the dwellings (see Table 3)

Performance Standards	Walls and Floors between flats/houses: airborne sound insulation $D_{nT,w}+C_{tr}$ (dB)	Floors between flats: maximum impact sound level $L'_{nT,w}$ (dB)
+3 over Part E	48 (minimum)	59 (maximum)
Note: internal walls and floors (to/between bedrooms/bathrooms) must be rated 40 dB R_w as a minimum requirement from Part E of Building Regulation		

Table 3: Internal walls and floors partition requirements

6.0 SITE

6.1 Existing Site

The existing site is as depicted in Figure 3.



Figure 3: Aerial view of the existing situation (main site circled in red)

The area is currently served by buses which has a stop on London Street.

The typology of the houses in the surrounding neighbourhood consists of a mix of 2-3 storey buildings; some of them with commercial use at ground floor.

6.2 Proposed Conversion

The proposal is for the change of use of one office building to 6 residential properties (class C3) and 1 commercial unit (Class E).

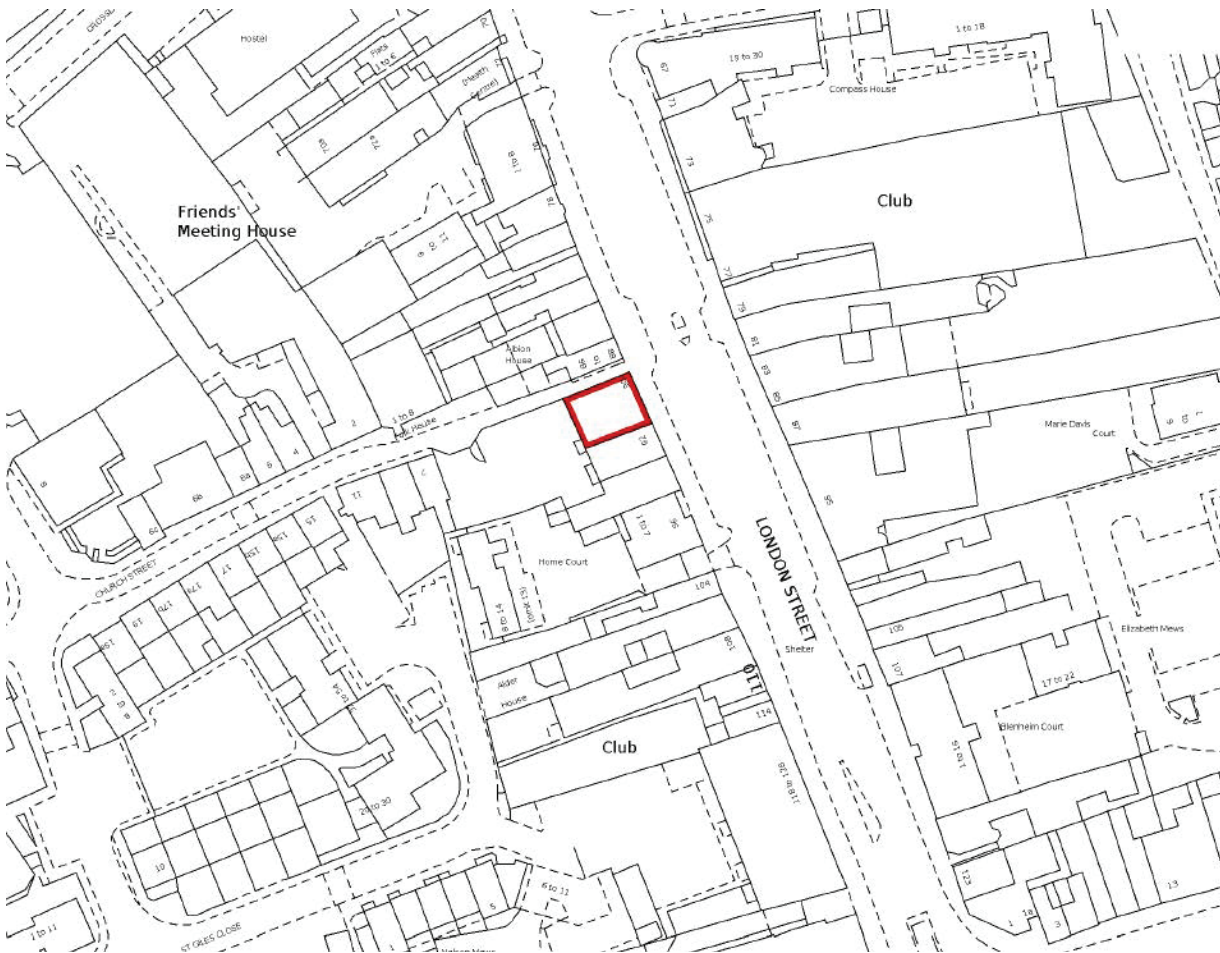


Figure 4: Proposed development – site plan

7.0 NOISE SURVEY

An environmental noise survey was undertaken between 28/02/2023 and 3/03/2023 in order to evaluate the existing noise climate.

The weather conditions were suitable for taking noise measurements. Calibration of the Sound Level Meter was made before and at the end of the measurements with no relevant drift observed.

7.1 Environmental Noise Survey

Both attended and unattended noise surveys have been undertaken at the locations depicted in Figure 5.



Figure 5: Location of the noise survey measurements (main site in dashed red line); S1 to S5 (short term measurements); L1 (long term measurement)

Short term (attended) measurements were taken from 2.30pm on 28/02/2023 to 12pm on 3/03/2023. These measurements consisted of continuous 10 minutes samples.

A Long term (unattended) noise survey was undertaken from 14:30 pm 28/02/2023 to 12:00 pm 3/03/2023; the equipment was placed on the exterior of the building at first floor level overlooking London Street. Results were recorded every 5 minutes with sampling every 1 second.

7.2 Noise Survey Results

Short Term Measurements

For each measurement location, Table 4 shows the results of the ambient noise level ($L_{Aeq,T}$), maximum level ($L_{A,F,max}$) and background noise level ($L_{A90,T}$). Results are rounded to the nearest integer value.

Measurement Reference	Measurement Location (as depicted in Figure 5)	Year/Mo/Day H:M:S	Duration T	$L_{Aeq,T}$ (dB)	$L_{A,F,max,T}$ (dB)	$L_{A90,T}$ (dB)
M1	S1	2019/5/16 12:35:55	10 min	60	79	44
M2	S1	2019/05/21 14:28:42	10 min	59	87 (80) ^[1]	46
M3	S2	2019/05/16 12:57:10	10 min	55	75	43
M4	S2	2019/05/21 13:41:00	10 min	55	723	41
M5	S3	2019/05/16 13:15:47	10 min	66	84	55
M6	S3	2019/05/21 14:09:55	10 min	66	93	54
M7	S4	2019/05/21 13:25:43	10 min	52	65	43
M8	S5	2019/05/21 14:46:37	10 min	60	82	51
^[1] The second highest $L_{A,F,max,T}$ value						

Table 4: Summary of noise levels from the short term noise survey

Long Term Measurements

The values of the ambient noise level ($L_{Aeq,T}$), the maximum level ($L_{A,F,max}$) and the background ($L_{A,90}$) noise level obtained from the long term noise survey are given in Table 5; a summary graph is given in the Appendix .

Measurement Location (as depicted in Figure 5)	Time period	Duration T	$L_{Aeq,T}$ (dB)	$L_{A,F,max,T}$ (dB) ^[1]	Minimum $L_{A90,5min}$ (dB) ^[2]	40 th percentile $L_{A90,5min}$ (dB) ^[3]
L1	Day time (07:00 – 23:00)	78 hrs	53	-	36	45
	Night time (23:00 – 07:00)	40 hrs	47	66	30	37
^[1] 90 th percentile of the measured $L_{A,F,max,5 min}$ measurements for that period ^[2] minimum value measured of the $L_{A90,5 min}$ measurements for that period ^[3] 40 th percentile of the measured $L_{A90,5 min}$ measurements for that period						

Table 5: Summary of the noise levels from the long term noise survey

Notes on the Survey

On London Street the main source of noise is cars and buses (which stop well away from the site). One side of London Street is used for in-line street parking for a quick stop for delivering or buying in the local shops. Parking is metered.

The car park to the rear of the property is used by residents. During the measurements, very few cars (approx. 12) parked.

Commentary on Noise Survey Measurements

As would be expected, the dominant noise source on the main streets is due to passing vehicles. Measurements taken to assess road traffic noise have shown consistency on the relevant acoustic parameters (see Table 4). Therefore, results can be considered representative of that noise environment.

The long-term noise survey has been undertaken to give an overall estimation of the noise indicators during the day and night. Results will be used as reference to set acoustic limits required to comply with the standards.

8.0 PREDICTED NOISE FOR THE PROPOSED DEVELOPMENT

A noise map was created using a widely used industry standard 3D environmental noise modelling software package, SoundPlan v8.1.

Methodology

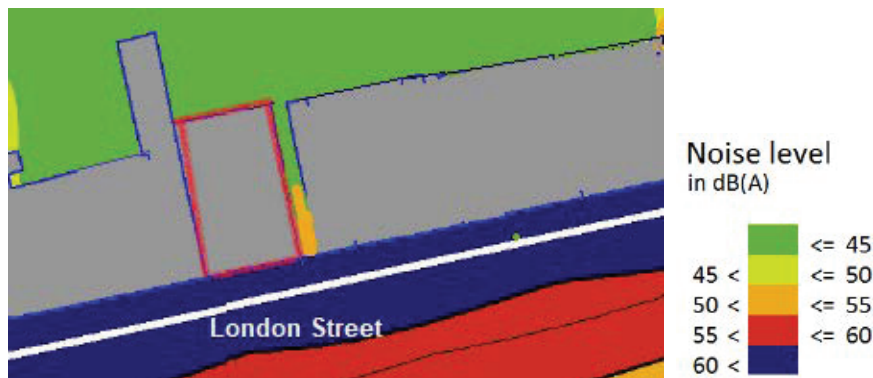
The model was built starting from a satellite map image taken from Google Maps used as a site reference. On top of that, the existing buildings were modelled and located accordingly; heights were estimated from images and Google Street View; while the proposed development scheme was modelled from the architect's drawings. Topographical elevations were included as well as the new serving routes. The noise emissions from roads have been calibrated against the survey results. To do so, sound power levels of the main noise sources, roads in this case, were adjusted in the model to agree as much as practical with the measured data. The resulting noise levels at each façade have been calculated both for day and night-time period.

The existing site has been modeled comprising with local roads and surrounding buildings. Noise emissions from roads have been calibrated against the survey results as previously described.

After the model has been calibrated, the proposed development was imported and modelled accordingly.

8.1 External Noise Levels - Existing & Proposed Scenario - Day

Figure 6 shows a noise map of the existing and proposed site area after being calibrated against the noise survey.



Red outline represent 90 London Street

Noise mapping of the existing and proposed situation

8.2 External Noise Levels - Proposed Development

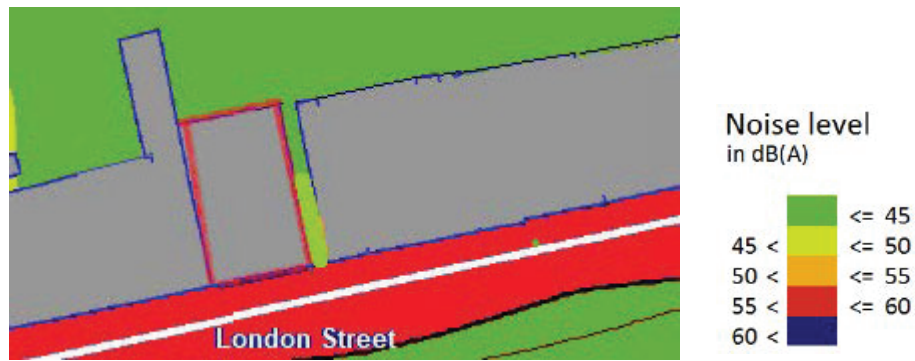
As this is a change of use, the Noise mapping and façade mapping for the proposed development are the same as the section above for the existing development.

Commentary on Results – Day time

The most exposed façades are the ones facing London Street, with noise levels that may exceed 60 dB (L_{Aeq}). The noise levels in the internal roads are between 45 and 50 dB (L_{Aeq}), and the predicted noise level at the internal court areas does not exceed 50 dB (L_{Aeq}), in line with the BS 8233 guideline for external amenity space.

8.4 External Noise Levels - Existing & Proposed Scenario - Night

Figure 7 shows a noise map of the existing and proposed site area after being calibrated against the noise survey.



Red outline represent 90 London Street

Noise mapping of the existing and proposed situation

8.4 External Noise Levels - Proposed Development - Night

As this is a change of use, the Noise mapping and façade mapping for the proposed development are the same as the section above for the existing development.

Commentary on Results – Night-time

At night, the predicted noise levels show that some façades overlooking London Street may be exposed to a noise level exceeding $L_{Aeq} = 55$ dB. A relatively low level, less than 45 dB L_{Aeq} , is estimated in the rear car park.

9.0 ASSESSMENT UNDER OVERHEATING CONDITIONS

As noted in Section 4.5, a Level 1 Risk assessment should be carried based upon the external noise levels and where a dwelling using opening windows lies in the Level 1 ‘High’ risk category, it is recommended that a more detailed ‘Level 2’ risk assessment is undertaken, considering predicted internal ambient noise levels.

Outcomes from the noise modelling have been compared against the AVO Guidance values (Figure 2) to investigate the AVO Level 1 Risk Category that each façade falls within.

9.1 AVO Level 1 Assessment

As shown in Figure 9, during the day (07:00 – 23:00) the predicted noise mapping results suggest that no façades fall into the “high-risk” category.



Figure 9: AVO noise level risk category – Day time

At night-time (23:00 – 07:00) the predicted noise mapping results show that facades (bedroom in this case) overlooking London Street do fall into the AVO Level 1 “high” risk category (see Figure 10).



Figure 10: AVO noise level risk category – Night-time

9.2 AVO Level 2 Assessment

An AVO Level 2 assessment involves a more detailed calculation of the likely internal noise levels based upon the predicted external noise levels and the acoustic performance of the façade. It is proposed that the façade is designed as such to avoid internal ambient noise levels exceeding 50 dB $L_{Aeq,16hr}$ during the day and 42 dB $L_{Aeq,8hr}$ during the night in the overheating condition in order to limit adverse effects as described in the AVO guide.

As it was only during the night-time that the facades facing the main roads fell in the Level 1 High Risk category an assessment has been carried out on bedrooms during the night in order to achieve the proposed performance standards.

The maximum window opening areas permissible to avoid exceeding the proposed performance standards have been calculated, as a % of the floor area, and are presented in Table 6.

Block	Rooms facing major roads	Rooms facing minor roads	Rooms facing courtyard
A	1% (N)	3% (E-W)	6%
B	1% (N)	5% (W)	5%
C	1% (N)	N/A	8%
D	1% (N)	N/A	8%
E	1% (W)	5% (N)	5%
F	1% (N-E)	5% (W-S)	N/A

Table 6: Window opening area (as % of floor area) to avoid noise level to fall into the “high risk” category as defined by AVO Guidance

10.0 BUILDING ENVELOPE REQUIREMENTS

Overview

The sound insulation properties of the building envelope depend upon the external noise levels present at each façade.

In order to ensure internal noise levels in accordance with the guidance of BS 8233:2014 an assessment of the minimum acoustic performance requirement of the façade elements has been undertaken considering the outcome from the noise mapping model.

10.1 Internal Noise Conditions

Façades, including any ventilation openings, must provide a minimum of sound insulation under background ventilation condition in order to achieve the required internal ambient noise levels:

- 35 dB $L_{Aeq,16hr}$ in living rooms and bedrooms during the day
- 30 dB $L_{Aeq,8hr}$ in bedrooms at night

The L_{Aeq} levels reflect current BS 8233:2014 guidance and they are not considered when windows are open.

10.2 Acoustic Performance of the Façade Elements

The acoustic rating requirements of the building envelope have been calculated from the outcomes of the predicted noise mapping model.

External Wall

The proposed minimum sound insulation performance for the external walls of the development is:

- External walls: 45 dB R_w+C_{tr}

It is understood that the likely construction will be of cross laminated timber (CLT) with an external brickwork and mineral wool insulation within the cavity. This build-up can achieve the required 45dB R_w+C_{tr} sound insulation criteria with the following minimum requirements:

- CLT minimum 40kg/m² (approx. 90mm)
- Cavity minimum 100mm
- Mineral wool insulation minimum 50mm
- Brick minimum 110kg/m² (approx. 70mm) on wall ties or similar

Background Ventilators

The ventilation strategy proposed for this project is based on a Mechanical Ventilation with Heat Recovery (MVHR) systems, installed in all dwellings. Therefore, no use of those background ventilators is required.

External Glazing

The proposed minimum sound insulation performance for the glazed element of the building façades are as follows:

- 35 dB R_w+C_{tr} for windows overlooking London Street
- 25 dB R_w+C_{tr} for windows overlooking the rear car park

Identification of the types of glazing performance are marked-up on a site plan drawing as shown in Figure 11.

Legend:

- Yellow Line: Glazing minimum requirement 35 dB R_w+C_{tr}
- Cyan Line: Glazing minimum requirement 25 dB R_w+C_{tr}

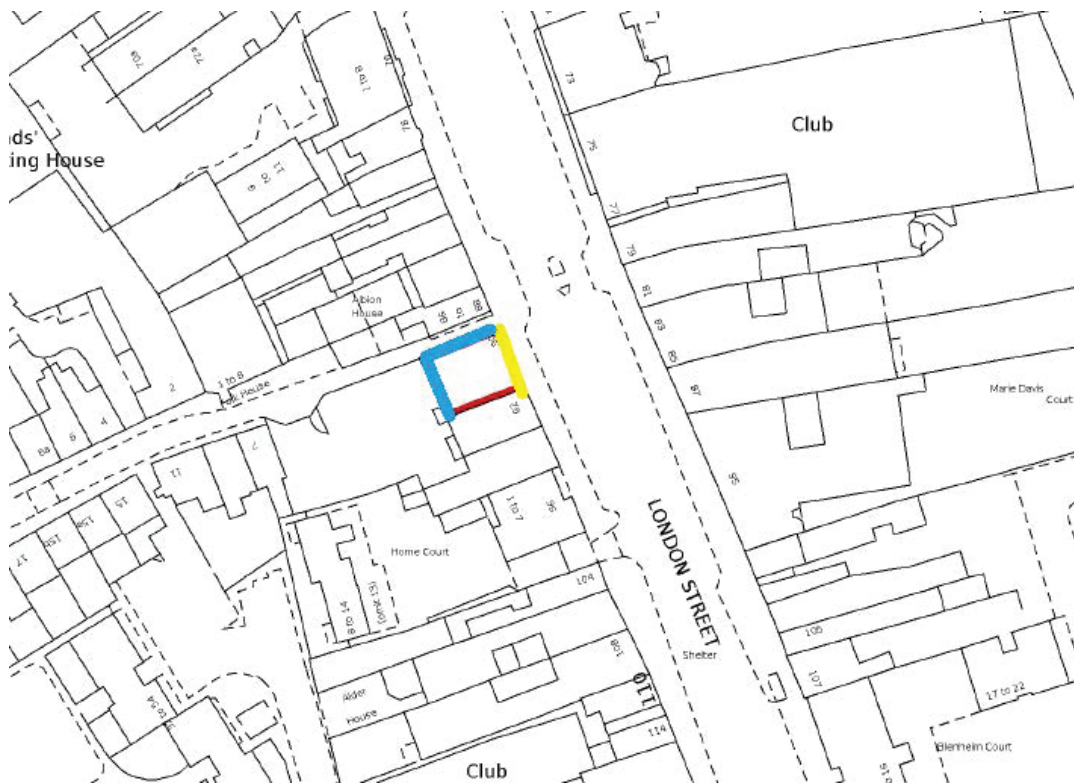


Figure 11: Scheme of the Acoustic Façade Performance elements (site area in red)

11.0 SUMMARY AND CONCLUSION

The proposed change of use of the site aims to provide 6 new homes as well as a commercial unit. The property has one neighbouring building, a rear car park, with the front of the building facing London Street. One side of the property is pedestrianised prohibiting vehicles from passing by.

Several short-term noise surveys around the subject area were undertaken to measure the existing noise climate across the site.

Existing representative background sounds levels have been determined, following the methodology of BS4142:2014, and used to define proposed plant noise rating limits ($L_{A,r,Tr}$ as per BS4142) at nearest sensitive receptors, of 44 dBA (day) and 37 dBA (night).

3D acoustic modelling using environmental noise mapping software, calibrated by the noise survey measurements, provides estimated external noise levels to the proposed building facades.

Acoustic requirements have been given for the external wall and glazing elements of the building facades in order to comply with BS8233:2014 guidance for internal noise levels

Areas of outdoor amenity space to the building courtyards will be exposed to noise levels <55 dBA ($L_{Aeq,16hr}$ day) and as such are within BS8233:2014 recommended upper limits.

An Acoustics Ventilation and Overheating (AVO) Level 1 assessment has been carried out based upon external noise levels. The level 1 assessment shows that bedrooms facing the main road fall within the high-risk category at night and as such an AVO Level 2 assessment has been carried out for these facades.

An AVO Level 2 assessment has been carried out for facades that fell into the AVO Level 1 high risk category. Maximum window open areas have been calculated for the relevant bedrooms which avoids internal ambient noise levels exceeding 42 dB $L_{Aeq,8hr}$ during the night in the overheating condition in order to limit adverse effects as described in the AVO guide.

In conclusion, with the measures outlined in this report, the development will meet the requirements of the local authority and relevant guidance and standards. In particular:

- External wall and glazing designed to achieve internal ambient noise level limits in line with BS 8233:2014.
- Daytime ambient noise level below 50 dB L_{Aeq} in the external amenity spaces, in line with the local Policy MK 2016-2031.
- A Level 2 risk assessment has been performed in accordance with the Acoustics Ventilation and Overheating guide showing that acceptable internal noise levels can be achieved with windows open providing additional ventilation to control overheating.

12.0 APPENDICES

12.1 Appendix A

Glossary of Acoustic Terminology

SOUND PRESSURE LEVEL (SPL), L (dB). The sound level measured on a logarithmic scale, with unit decibel dB. A free-field SPL refers to a level determined far enough from surfaces or façades, apart from the ground, so as not to be influenced by reflections from those surfaces.

A-WEIGHTED SOUND PRESSURE LEVEL (SPL), L_A (dBA). A-weighted SPL values (or noise levels) are weighted in a way that approximates the frequency response of the human ear and allows sound levels to be expressed as an overall noise level from octave or third octave band frequencies.

EQUIVALENT CONTINUOUS A-WEIGHTED SPL, L_{Aeq,T} (dBA). Energy weighted average of the A-weighted sound pressure level over a time period, T. The level of a notional continuous sound that would deliver the same A-weighted sound energy as the actual fluctuating sound over the course of the defined time period, T.

MAXIMUM A-WEIGHTED SPL, L_{Amax} (dBA). The maximum A-weighted sound pressure level measured. If not specified, usually assumed to mean L_{AFmax}, i.e. L_{Amax} determined with a 'fast' (F) sound level meter time constant of 125 ms.

PERCENTILE NOISE LEVELS L_{A1,T}, L_{A10,T}, L_{A90,T} (dBA). The value of the A-weighted sound pressure level that is exceeded for N% of any given time interval, T. For example L_{A1,T} is the value that is exceeded for 1% of the measurement period. L_{A90,T} is the level that is exceeded for 90% of the measurement period, and is usually used to represent the ambient background sound level.

SOUND REDUCTION INDEX, R (decibels, dB). The sound reduction index of an element such as a wall, floor, door or window describes proportion of incident sound that is not transmitted by that element. R varies with frequency and can be expressed either in terms of the fraction of incident sound energy that is transmitted or in terms of the difference in SPL on either side of the element.

WEIGHTED SOUND REDUCTION INDEX, R_w (decibels, dB). A value calculated from the frequency dependent values of sound reduction index, measured in a laboratory and weighted according to a method described in BS EN ISO 717-1. This allows the sound reduction of an element to be expressed in terms of a single value.

REVERBERATION TIME, RT (seconds). The reverberation time of a space is the time taken for the reverberant sound energy to decay to one millionth of its original intensity (corresponding to a 60 dB reduction in the SPL).

MID-FREQUENCY REVERBERATION TIME, T_{mf} (seconds). The arithmetic average of the reverberation times for the 500 Hz, 1 kHz and 2 kHz octave bands. This quantity is used most often to describe the reverberation time. In BB93, the maximum acceptable T_{mf} is specified.

SOUND LEVEL DIFFERENCE, D (dB). The difference in sound pressure level between rooms on either side of a partition, $D = L_1 - L_2$ (where L₁ and L₂ are the sound pressure levels on either side of the partition). D varies with sound frequency.

STANDARDIZED LEVEL DIFFERENCE, D_{nT} (dB). The sound level difference of a partition adjusted to account for the difference between the actual receiving room reverberation time and a reference reverberation time.

$$D_{nT} = D + 10 \log_{10}(T/T_0)$$

where T is the actual reverberation time of the receiving room and usually T₀=0.5s (e.g. for residential pre-completion testing), although BB93 (2014) assigns a room's maximum allowable T_{mf} (i.e. T₀=T_{mf,max}).

WEIGHTED STANDARDIZED LEVEL DIFFERENCE, $D_{nT,w}$ (dB). A value calculated from the frequency dependent values of the standardized level difference, D_{nT} , according to a weighting method described in BS EN ISO 717-1. This allows the sound level difference of an element to be expressed in terms of a single value. Note $D_{nT,w}$ ($T=T_{mf,max}$) is used in BB93 (2014) which is the same quantity but derived from standardized level difference values which are calculated using $T_0=T_{mf,max}$.

IMPACT SOUND PRESSURE LEVEL, L_i (dB). Average sound pressure level in a specific frequency band in a room below a floor, when the floor is excited by a standard tapping machine as defined in BS EN ISO 140-7:1998.

STANDARDIZED LEVEL DIFFERENCE, L_{nT} (dB). The sound pressure level adjusted to account for the difference between the actual receiving room reverberation time and a reference reverberation time of $T_0=0.5$ seconds.

$$L_{nT} = L_i - 10 \log_{10}(T/T_0)$$

where T is the actual reverberation time of the receiving room and usually $T_0=0.5$ s. (e.g. for residential pre-completion testing), although BB93 (2014) assigns a room's maximum allowable T_{mf} (i.e. $T_0=T_{mf,max}$).

WEIGHTED STANDARDIZED IMPACT SPL, $L'_{nT,w}$ (dB). A single value calculated from the frequency dependent values of the standardized impact sound pressure level, L'_{nT} , according to a weighting method described in BS EN ISO 717-2. Note $L'_{nT,w}$ ($T=T_{mf,max}$) used in BB93 is the same quantity but derived from standardized level difference values which are calculated using $T_0=T_{mf,max}$.

12.2 Appendix B

Noise Exposure Hierarchy Table (Paragraph: 005, Reference ID: 30-005-20190722, Revision date: 22-07-2019)

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

12.3 Appendix C

Noise Monitoring Equipment

The equipment summarised in Table 7 has been calibrated by a UKAS accredited laboratory in accordance with the laboratory requirements of the United Kingdom Accreditation Service (UKAS) on the dates indicated.

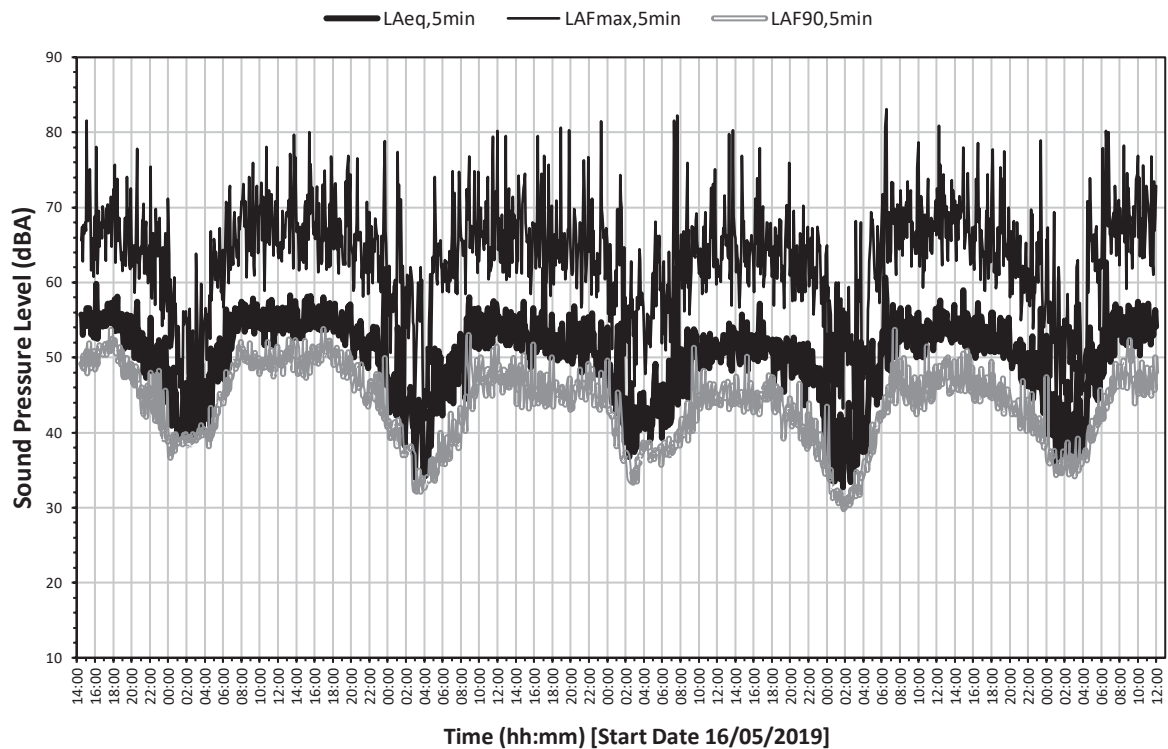
UKAS calibration data sheets and certificates are available upon request.

Item	Make	Type	Serial no.	Calibration Certificate Number
Class 1 sound level meter	Norsonic	140	1406755	U29791
Microphone	Norsonic	1225	251518	29790
Microphone preamplifier	Norsonic	1209	21284	U29791
Calibrator	Norsonic	1251	34890	U30827

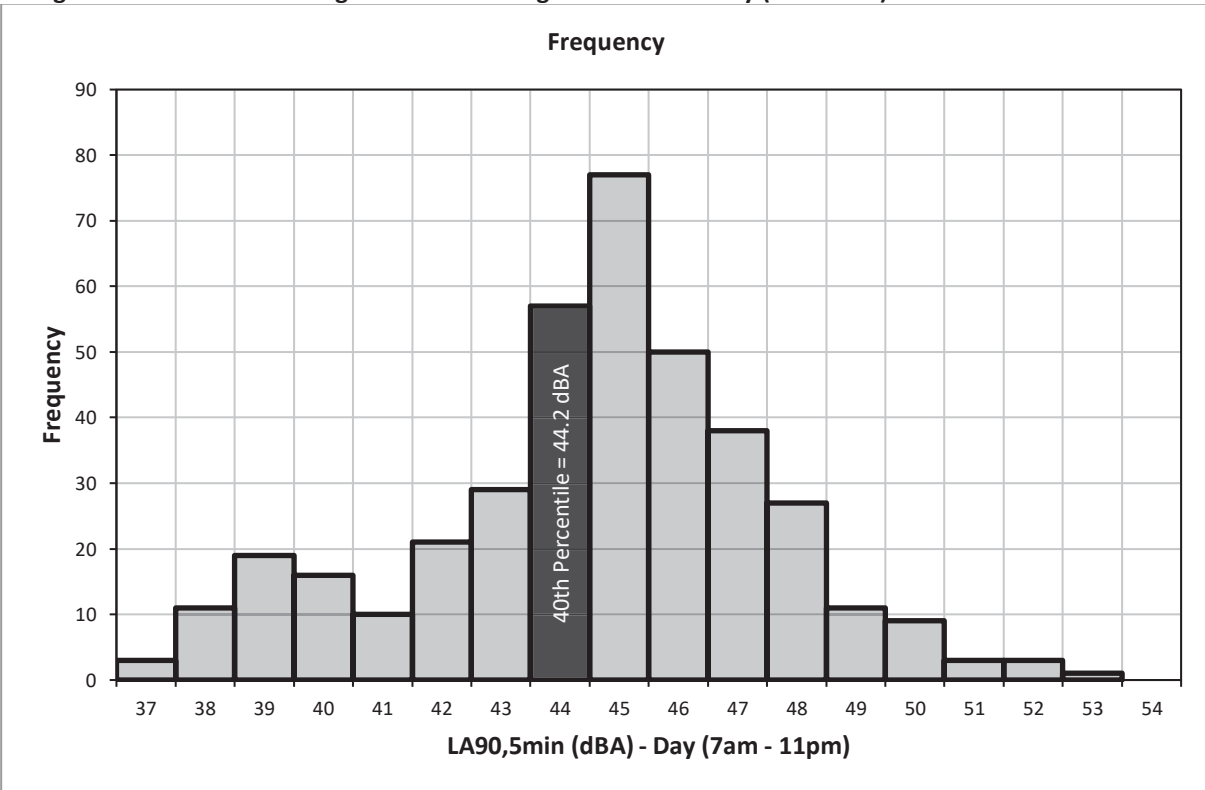
Table 7: Calibration details

12.4 Appendix D

Graphs Results of the long term noise survey showing L_{Aeq} , $L_{AF,max}$ and L_{A90}



Background Noise level - histogram from the long-term noise survey (week-end)



Background Noise level - histogram from the long-term noise survey (week-end)

